Utah Space Grant Consortium
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Consortium URL: http://www.utahspacegrant.com
Grant Number: NNX10AJ77H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary spa-ce-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Utah Space Grant Consortium is a Designated Consortium funded at a level of $575,000 for fiscal year 2013.

PROGRAM GOALS

Outcome 1: To demonstrably contribute to the development of the STEM Workforce with programs, projects and activities that are in direct alignment with NASA's stated education strategic goals, missions and with her defined outcomes, objectives and PART measures.

SMART Objectives:

1: Increase the percentage of our Space Grant Fellowships and Scholarships given to female students from an average of 32% in 2005-2009 to 40% in 2010-2014. Increase the percentage of awards to minority students from an average of 27% in 2005-2009 to 30% in 2010-2014. This will maintain greater diversity in our Space Grant program compared to the demographics of the State, where 23% of the students are female and 13% are minorities. This will keep our percentages well above the NCES Digest Statistics, where 22% of the students are female and 11% are minorities.

2: a) Improve the process throughout the Consortium by which Fellowships are announced, applications solicited, applications competitively reviewed, awards made, administered and tracked. Our Consortium web site will be revised to have application links from each of the three research universities: U of U, BYU, and USU, so that student applicants can see the specific requirements set forth from these three affiliate institutions. b) From 2005-2009 we awarded an average of 22 Fellowship awards each year. In 2010 we plan to award 17 Fellowships at the graduate student level. All of these awards will be above $5,000 tracking level. The number of Fellowships awarded in 2010 is less than

in 2009 due to the total Space Grant funding in 2010 being $575 K rather than $785 K in 2009. c) From 2005-2009 students and faculty published an average of 34 scientific reports each year. From 2010-2014 we plan to publish an average of 34/year.

3: Each year target at least three project areas to focus Space Grant interdisciplinary research and development selected from [1] space systems engineering (ESMD-spacecraft), [2] life support in space (SOMD-crew health, safety, medical ops), [3] space vehicle propulsion (ESMD-propulsion), [4] remote sensing by optical, infrared and microwave imaging (SOMD-space comm.) in direct alignment with NASA Enterprise priorities.

4: From 2005-2009 we awarded an average of 25 undergraduate Scholarships each year. From 2010-2014 we plan to award 29 Scholarships at the undergraduate level each year. Of these awards, 8 will be above $5,000 and 11 will be below the $5,000 tracking level**.**

5: Increase the number of research infrastructure minigrants awarded to junior faculty members of our Consortium as an investment in their space-related research and career development. From 2005-2009 we made an average of 2 awards. In 2010 we plan to make at least 5 awards to junior faculty members.

6: In 2010 we proposed to fund 11 student internships each year at NASA Centers. In 2012-2014 we propose to award four student internships each year (stipend plus round trip travel) to participate in summer research at NASA centers.

7: From 2005-2009 7% of our Space Grant students graduated with STEM degrees and entered the STEM workforce. From 2010-2014 we plan on 9% of our students graduating with STEM degrees and starting their careers in the STEM Workforce. From 2005-2009 16% of our Space Grant students graduated with bachelor degrees and entered graduate school declaring a STEM major. From 2010-2014 we plan on 18% of our students graduating with degrees and entering advanced degrees declaring a STEM major.

Outcome 2: To attract and retain students and teachers in the STEM disciplines who have a solid understanding of the subject material.

SMART Objectives:

8: From 2005-2009 we conducted an average of 9 teacher career development workshops each year. From 2010-2014 we plan to conduct 10/year.

Outcome 3: Conduct an Informal Education program to form strategic partnerships and linkages between STEM formal and informal providers leading to an expansion of the nation's future STEM workforce through awareness of the mission of NASA and the promotion of STEM literacy.

SMART Objectives:

9: From 2005-2009 we supported the activities of 3 informal STEM education partnership collaborative projects each year. From 2010-2014 we plan to support 4 informal educational collaborative projects each year.

10: Annually develop 4 sets of informal education standards-based STEM materials to enrich visual and activity experiences by informal education

providers. Support satellite facilities that make this material available to teachers.

Management:

SMART Objective:

11: Provide one single point of contact for our consortium, namely Dr. Joseph Orr, Director/PI. Our Education Administrator and Program Coordinator will report directly to Dr. Orr and help facilitate all consortium activities, including reporting, proposal preparation, and responding to NASA's requests.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1, 2, & 3)

Outcome 1. Development of STEM Workforce

NASA Space Grant funds have supported the research of Utah State University graduate fellowship student, Kyle Horne. Kyle has performed research into the effects of nanoscale semi-periodic layer structures on the thermal properties of materials, specifically the thermal conductivity. This topic has direct applications to several areas of interest for NASA, including thermoelectric power generation and advanced thermal management of nanoscale systems. These applications are crucial to the development of future space probes and rovers. Kyle and his mentor, Dr. Heng Ban, seek to calculate the effective bulk thermal conductivity of these materials using molecular dynamics and to validate those simulation results using photothermal methods.

To accomplish this task, they have acquired samples of quantum cascade laser (QCL) diodes, which are composed of layered structures just like those noted previously. These structures are rebuilt on the computer for simulation by the LAMMPS molecular dynamics program from Sandia National Lab. After computing and recording the system heat flux during simulations, the heat flux autocorrelation is computed and then integrated. Using this integral, the effective thermal conductivity of the system as a whole can be computed using the Green-Kubo relationship. The simulations reveal that the presence of semi-periodic layers degrades the thermal conductivity of the III-IV semiconductors of which the QCL is composited from a range of 20-50 W/mK to the range of 3-6 W/mK. This degradation can be used to optimize thermoelectric generators or control thermal transport in nanoscale systems.

Ryan Lundgreen, fellowship awardee from Brigham Young University, has conducted more than 100 multiphase CFD simulations over the past year in the process of investigating the performance of a liquid rocket engine inducer with and without a stability control device (SCD). Improving the suction performance of a turbopump has been the goal of researchers for decades. Many improvements have been made to inducer designs to allow them to operate stably at lower and lower inlet pressures. Many inducer properties, such as blade sweep and tip clearance, have had extensive research performed to better understand how to optimize an inducer design. There has not been any research published on the benefits of three-bladed inducers versus four-bladed inducers. Analysis was done by Ryan on two different inducers (three-blade version and four-blade version) with similar tip clearance, blade angle, solidity, and blade sweep. Simulations were run at the design flow coefficient and at a flow coefficient lower than

the design point. Results showed that the four-bladed inducer maintained stability and experienced lower rotordynamic forces, but the three-bladed inducer operated with better performance at lower inlet pressures. These results were published and presented at the AIAA Joint Propulsion Conference in San Jose, California.

Research was also performed by Ryan Lundgreen on a baseline inducer with and without an SCD. Without an SCD, the inducer was very limited in the range of flow coefficients at which it operated stably. The presence of an SCD allowed the inducer to operate stably at flow coefficients far below the design flow coefficient. At lower flow coefficients, the inducer is able to operate stably at much lower inlet pressures. This research is significant to NASA because it would allow for lower pressures in fuel tanks. Thinner walls would be required to maintain structural stability in the tank, resulting in a reduction in cost and increased safety and reliability for the payload. These results were presented in a poster at the ASME International Mechanical Engineering Congress and Exposition. The results are being refined currently for future publication.

Outcome 2: Attract and retain students and teachers in the STEM disciplines
This year the Clark Planetarium set a new record for both number of teachers served and number of workshops completed. They held 28 teacher workshop sessions which provided in-depth experiences for 451 teachers in 21 districts across the state of Utah. Using an inquiry-based approach, teachers significantly improved their mastery of seasons, moon phases, light, angle of incidence, eclipses and discover why we see different constellations at different times of the year. Teachers discovered how to enhance student learning through the use of the existing "Seasons & Moon Phases" kits and gain confidence and competence in lesson delivery by participating in the lessons as their students will. Overall, these activities have been proven to work in classrooms throughout Utah. They have been designed using the best practices of addressing misconceptions head-on. This requires participants to make predictions, conduct experiments to see whether their predictions are supported by evidence, and then reformulate their thinking based on the results of the activities and data acquired. Throughout their development, these lessons were evaluated by leaders in our state science education community and revised based on evaluator input. Timely feedback helps Clark Planetarium adapt their workshops to the teacher's needs. They are now equipped to bring these activities into classrooms around the State.

PROGRAM ACCOMPLISHMENTS

Outcome 1: Development of STEM Workforce

SMART Objectives:

1. During FY 2013 we awarded 42 fellowships and scholarships. Twenty of these were awarded to female students (47.6%) and 17 were awarded to minority students (40.5%). We were above our base funding goal of 40% for female students and above our base funding goal of 30% for minority students.

2. We have continued to utilize the new website for the Utah Space Grant Consortium for fellowship and scholarship applications for each of our three research universities. The applications were implemented to standardize the application process

and to make students aware of the requirements and stipulations involved with the fellowship/scholarship awards. A review board at each affiliate institution reviews and selects the award recipients. Awards are made, administered, and tracked by each individual affiliate and our Program Coordinator works with each affiliate regularly to maintain the database of all awards and student information to feed into the longitudinal tracking system of the Education Program Support Services (EPSS). In FY 2013, we awarded 23 graduate fellowships (13 PhD, 10 MS) with base Space Grant funding, thus exceeding our objective to use base finding to provide 17 graduate fellowships. Twenty of the twenty-three graduate fellowship awards were considered significant in the longitudinal tracking system due to receiving $5,000 award or more and/or spending 160 hours or more.

A total of 53 papers were submitted to professional journals, conferences and symposia, or published by our students. Our target was 34 papers per year so we have exceeded our goal. Twenty-eight papers are being published in the Proceedings of the 20th Annual Utah Space Grant Graduate Fellowship Symposium plus a total of 25 professional paper and conference submittals were made to professional journals and institutes appropriate to the relevant scientific or engineering specialty. These included Astrophysical Journal, IOP Science Journal of Instrumentation, BYU Physical and Mathematical Sciences Student Research Conference, AIAA Atmospheric Flight Mechanics Conference, AAS Meeting, APS Four Corners Meeting, AGU Fall Meeting, IAGA Scientific Assembly, CEDAR Workshop, USU Physics Colloquium, International Symposium on Functional and Logic Programming (FLOPS), American Astronomical Society, Ecological Society of America, Society of Range Management, International Workshop on Subsecond Thermophysics, Thermal Nanosciences Nanoengineering, Physical Review, and NIST Ion Storage Group.

3. When awarding fellowships and improving research infrastructure, the University of Utah targeted life support in space; Utah State University targeted space vehicle propulsion and space systems engineering; Brigham Young University targeted space systems engineering and remote sensing by optical, infrared and microwave imaging. We exceeded our objective of targeting three areas by focusing on all four areas of research in our SMART objective.

4. We awarded 19 undergraduate scholarship awards in FY 2013. This did not meet our original goal to award 29 undergraduate scholarships. Due to decreased funding in FY 2013 (no augmentation funds at the time of this reporting), we did not place as much emphasis on undergraduate scholarships in FY 2013. Of these 19 undergraduate scholarship awards, none were above the $5,000 tracking level or minimum hours requirements and were therefore, not included in the longitudinal tracking system. Although not longitudinally tracked, we consider our annual awards of multicultural scholarships to be unique in that in some cases it helps the students to stay in school and continue their education in the STEM fields.

5. Two research infrastructure minigrant awards were awarded during FY 2013 and an additional three awards are being advertised and planned to be funded in the near

future. The following two research infrastructure minigrant awards were granted: (1) POCPACS Space Weather project which was deployed into orbit on a SpaceX Falcon 9 rocket on September 31, 2013, at Utah State University, Dr. Gil Moore, and (2) Balloon Flight Measurements with a Red-Line Airglow Sensor (RLAGS), at Utah State University, Dr. Rees Fullmer. Research Infrastructure awards are currently being announced via internal request for proposals at Brigham Young University and the University of Utah but faculty awardees have not yet been selected and funded. Therefore, we will meet or exceed our goal of awarding five research infrastructure minigrant awards for FY 2013 after all of the awards have been issued by May 2014.

6: We have budgeted and are planning to use FY 2013 funding to support three interns at NASA Centers during the summer of 2014. At the time of this submission, we have only received one application to consider for funding for summer 2014 internships. However, we expect several from OSSI, LARSS, or NASA Academy to be received in March 2014 to review and endorse. After our review of these applications, we will fund three students for summer 2014 internships. Our goal was to fund four interns per year, however due to limited funding in FY 2013, we are only able to support three interns during the summer of 2014. The internships being funded include stipends of $5,000 each and round-trip travel costs.

7: Eleven of our fellowship students made their next career steps in FY13 (SG participation supported from FY06-FY13 funds). Four students are pursuing advanced degrees in STEM disciplines, one student accepted a STEM position at a NASA contractor, four students accepted STEM positions in industry, one student accepted a STEM position in K-12 academia, and one student went on to a position in a non-STEM discipline. We had 9% of our students graduate with STEM degrees in FY13 (our SMART objective was 9%). In FY13 we had 5% of our students graduate with STEM degrees and pursue an advanced degree with a STEM major (our SMART objective was 18%). The lower percentage this year is due to a majority of our funded graduate students still being in school working on the same degree.

Outcome 2: Attract and retain students and teachers in the STEM disciplines

SMART Objectives:

8: We have conducted two teacher workshops and plan an additional nine teacher workshops using FY 2013 precollege funds making a total of 11 teacher workshops in FY 2013. These workshops were held or are being planned at the following locations on the specified dates: (1) Hillcrest Elementary School (February 6, 2014), (2) Davis School District (March 1, 2014), (3) Logan and Cache School Districts (May 22, 2014), (4) Wendover High School, target 8th grade science teachers (May 8-9, 2014), (5) Vernal & Roosevelt, Eagle View Elementary school in partnership with GEAR UP Program (May 13, 2014), (6) Brigham Young University, target engaging students in science (June 4-6, 2014), (7) Orem & Vernal, target topic of geology (June 9-13, 2014), (8) West Lake School, Saratoga Springs, target physics, chemistry, and rockets (June 16-20, 2014), (9) Hill Aerospace Museum & Davis School District, target astronomy, constellations and solar system (June 18-19, 2014), (10) Capital Reef State Park, target topic of astronomy (June 23-27, 2014), (11) Lindon, target methods used to teach science (July 5, 2014).

The total number of workshops performed during FY 2013 will be 11 which exceeds our goal of conducting an average of 10 workshops/year during the 2010-2014 award periods.

Outcome 3: Informal Education program to form strategic partnerships/linkages

SMART Objectives

9: New informal education partnerships were established with (1) GEAR UP program at Utah State University; (2) Utah Division of Indian Affairs including Ed Galindo and Shirley Silversmith; (3) Alpine, Jordan, Granite, Davis, Weber, and Ogden School Districts through the meteorite program we have been developing and implementing across the state of Utah; and (4) Ott Planetarium in conjunction with the Weber State University College of Science and their "Science Saturday" program. We facilitated our goal of four new STEM informal education partnerships this past year as stated in our objective.

10: We developed and distributed four sets of educational materials on-line and in hard copy. We met our objective to develop and distribute four sets of STEM educational materials. These educational materials covered the subjects of: (1) meteorites (new set of materials for FY 2013, different from what was distributed in FY 2012), (2) phases of the Moon, (3) seasons of the year, and (4) Earth's Moon origin. Each of these four areas are also targeted in a majority of our science teacher workshops and teachers are given sets of educational materials in handout form, on-line and in real-world objects in these areas to take back to their classrooms for implementation as they teach.

Management

SMART Objective

11: The organizational structure of the consortium has continued to have one Space Grant/EPSCoR Director/PI and one University Sponsored Projects Office Director as the two formal points of administrator contact with the NASA HQ Space Grant/EPSCoR Office.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:** The Utah Space Grant Consortium collects required student data from each student when they apply, when each award is made (via student data award form), and before our annual Fellowship Symposium conducted in May of each year. Since 2009, our Consortium has been utilizing the services of the National Space Grant Foundation/EPSS for longitudinal tracking. We have continued to work closely with the EPSS staff to report all student award information. FY 2013 data includes: Total awards = 46; Fellowship/Scholarship = 42, Higher Education/Research Infrastructure = 4; (*Note: We are still in the process of finalizing some higher education and research infrastructure student awards so this number will increase when our final report and student data tables are submitted later this year*.) Seventeen (40.5%) of the total awards represent underrepresented minority F/S funding. During the FY13 program year, four students are pursuing advanced degrees in STEM disciplines, one accepted a STEM position at a NASA

contractor, four accepted STEM positions in industry, one accepted a STEM position in K-12 academia, and one went on to a position in a non-STEM discipline. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.

- **Diversity of institutions, faculty, and student participants.** Our Consortium changed our goal in FY 2011 to increase diversity by targeting more awards to female and minority faculty and students. We have continued this effort in FY 2013 to maintain the same goals set forth. All of our research universities (University of Utah, Brigham Young University and Utah State University) allocated a certain portion of fellowship/scholarship and higher education funding toward this effort. This has resulted in percentage of females awarded and percentage of minority participants to both be above our goal in our reporting this year. During FY 2013 we awarded 42 fellowships and scholarships. Twenty of these were awarded to female students (47.6%) and 17 were awarded to minority students (40.5%). Utah's largest minority sub-population is Hispanic (13% according to 2010 census). In FY2013, we funded nine Hispanic students (21%) which is a 14% increase from last year as we noted one of our priorities was to increase funding to this group in Utah. One program that Utah Space Grant supports that targets the Hispanic group of students is the NASA Space Science Day program put on by the Society of Hispanic Professional Engineers (SHPE). This annual event is held in March of each year on the campus of Utah State University.

- **Minority-Serving Institution Collaborations:** There are no designated minority-serving educational institutions in Utah. However, Weber State University and Salt Lake Community College have large Hispanic student populations with whom we have joint activities.

- **NASA Education Priorities:**
  - **Authentic, hands-on student experiences in STEM.** The Utah Space Grant Consortium places high priority on giving students hands-on opportunities to do research projects. These students are funded through our fellowships and scholarships, higher education and research infrastructure programs. Following are examples of six student's experiences who were funded in FY 2013.

    "The Utah Space Grant gave me the opportunity to complete my first research experience. With this opportunity, I conducted two projects this summer concerning the Great Salt Lake. In my first project, which I am presently working on, I am investigating the genetic origins of mercury resistance in microorganisms in the Great Salt Lake. Mercury-resistant microorganisms can either methylate or demethylate mercury depending on which gene pair (hgcAB or merAB) the organism possesses. The specific genotype these microbes express in turn affects the health of the lake. I seek to determine which mechanism my cells are using and to what degree is their resistance to mercury. In order to do this, I have isolated and cultivated microbes from the lake and have slowly increased the concentration of mercury chloride in their nutrient media. Those that survive in

these conditions are considered mercury resistant. Currently, I am performing genetic analysis on my mercury resistant isolates to determine which cells are methylators and which are demethylators. My second project also concerns microorganisms from the Great Salt Lake. In this study, I sought to improve the cultivation methods used to culture these types of cells. I began the project during the summer and completed the study in December 2013. My results showed that my new method of cultivation facilitated a greater diversity of microorganisms, which was my objective. I presented both of my studies for the Great Salt Lake Audubon Society in October 2013. I will also be presenting the mercury project at the Utah Conference of Undergraduate Research on February 28, 2014. As you can see, this grant has provided me with invaluable research experience and has given me the opportunity to present at two conferences. This experience will be very helpful as I enter into graduate school and begin a career in research." (Ashtyn Smith - on 01/27/14, 2013 Higher Education/ Westminster College, Neuroscience EEG Lab, Dr. Lesa Ellis, Westminster College - Research Assistant)

"The Utah Space Grant provided unique opportunities to present my research and receive feedback from industry personnel. This opportunity enhanced my degree in that I was able to work on something of interest to me while pursuing a masters degree in statistics." (Brittany Spencer - on 07/18/13, 2013 Higher Education Award, 2013 Space Grant Fellowship)

Derek Ostrom, undergraduate scholarship student in physics, spent the summer of 2013 working on a 20-inch telescope that resides on West Mountain. This telescope is used for rapid response imaging. He is currently awaiting spring weather when he will have first light on the new telescope. Derek reconfigured the remote communication hardware, worked on the dome rotation, worked on the telescope control, and did a lot of very good and useful work in getting the pointing controller functioning. Derek plans to have astronomical pictures available in the spring of 2014 as feedback on this research work.

Adam Johanson, graduate fellowship student in physics, was able to travel to Australia to use the Australia Telescope Compact Array (ATCA), a radio interferometer. He was among the exotic plants, trees, birds, and even the dozens of kangaroo hanging out on the side of the highway, one of which took some shade under one of the massive radio antennae. At night, as he gazed at foreign stars and constellations, the telescopes collected radio emission from young, massive stars over 150,000 light years away. Adam is currently analyzing this data and will publish his second paper with ATCA results later in 2014.

Andrew Kent, graduate fellowship student in computer science, was able to focus on research verifying security protocol analysis techniques using the Coq Proof Assistant (a theorem proving tool founded in the Calculus of Inductive Constructions). He made enough progress in this endeavor that he was able to submit a full research paper on his progress to the Twelfth International

Symposium on Functional and Logic Programming. “This research project has truly been an edifying and exciting experience that has helped me develop the skills and knowledge that will allow me to achieve my long term research goals.”

Over the last year, Alex Harding, graduate fellowship student in electrical engineering, has been developing a scrubber for the Kintex 7 FPGA from Xilinx Inc. A C program was developed to perform configuration scrubbing of the FPGA through a USB to JTAG converter. An internal scrubbing mechanism built into the FPGA was used to increase the operation speed of the scrubber. This internal scrubber is capable of fixing single bit errors, while the C program is used to fix multi-bit errors. This design was tested and verified in a neutron beam at LANSCE in Los Alamos, NM.

- **Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise.** The Utah Space Grant Consortium currently has 12 sets of meteorites which have been placed in colleges, universities, or State school districts in Utah. Our goal with this program is to make two items (a 10-14 pound meteorite and a slab of a meteorite approximately four to six inches in diameter and ¼ of an inch in thickness) available to as many middle school teachers and therefore, students, as possible. The slab, cut with a diamond saw, has been polished and treated so as to show the exquisite and beautiful molecular configuration of the inside of these lead and iron space rocks. There are approximately 330,000 K-6 students in the state of Utah. By making these 12 sets available to schools, we plan to have between 175,000 and 200,000 students touch, hold, and handle a real meteorite. In FY 2013, the meteorite program has continued to grow in numbers of schools, students, and teachers who participate actively in our astronomy workshops. One of the reasons for the increased use of these displays is the frequency in which we make contact with the Space Grant affiliates and Utah school districts to inquire as to just what we might do to assist them to make this program more effective. The appropriate science personnel in each of the institutions where the meteorites reside have been asked to keep track of how many of the potential users are taking advantage of the opportunity make these displays available in their classrooms in a hands-on experience. They are asked to report every six months as to how many schools, students, and teachers have used these displays in the classrooms. Some have been invited to our annual Space Grant meeting in May 2014 to report on their efforts.

  In FY 2013, Utah Space Grant has partnered with Utah State University’s GEAR UP program and partnered with them in science teacher workshops for middle school teachers. The curriculum presented at workshops during this current year includes: chemistry, inheritance/heredity, photosynthesis, expanding universe, electricity, earth science, animal adaptations, physics, underwater robots, and microbiology.

Space Grant funding continues to support Snow College's portable planetarium program. Higher education students and faculty in the Math and Astronomy Department at Snow College takes the portable planetarium to local schools to instruct teachers and students in astronomical concepts that align with the State of Utah core curriculum. Scholarships are provided for a few students at Snow to develop the lesson plans to coincide with the curriculum.

- **Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.** FY 2013 was the ninth year for affiliate, Westminster College, to host the AWE+SUM (Attend Westminster, Explore Science, Use Math) camp for girls entering the 8th grade in the fall. The 3-day residential camp this year was held June 17–19, 2013, with 67 girls attending. Nearly all girls were from Utah, with a few from surrounding states. Recruiting is active from Title 1 schools and through Native American channels, so about half of the girls each year are from minority ethnicities. The group this year included 13 from the Ute Reservation in Ft. Duchesne, Utah, as well as 7 other Native American girls. The purpose of the camp is at least two-fold: (1) Showing girls that math and science really are fun subjects. Eight workshops conducted by math and science (female) faculty endeavor to get the girls excited about math, physics, chemistry, biology, computer science and aviation through hands-on workshops. Some girls who attend are already excelling in math and science classes, but even they benefit from seeing female role models in those fields; and (2) Convincing all attendees that they should aspire to further education. The girls come from an entire spread of backgrounds, from girls whose parents both have advanced degrees, to girls whose parents never finished high school. Success in this program means at least opening the eyes of these young female participants to all of the possibilities for them.

  Utah Space Grant has continued to support the Empowering Your Tomorrow (EYT – targets 6th – 12th grade boys) and Expanding Your Horizons (EYH – targets 6th – 12th grade girls) conferences held annually on the campus of Utah Valley University. The purposes of these conferences are to introduce students to a variety of career choices to inspire them to seek higher education and to graduate from college. Role models are provided in their fields of interest who offer resources to parents and educators which help students succeed. Female participants are also introduced to non-traditional careers for women and are encouraged to take math, science and technology classes. These conferences are planned by the Utah Valley University Equity in Education Center.

- **Community Colleges.** Our consortium has three community college affiliates: Salt Lake Community College, Snow College and Utah College of Applied Technology (UCAT). In FY 2013, Space Grant funds were distributed to these affiliates and they were involved with higher education programs at their institutions to expand opportunities for students in the STEM fields. We are looking forward to some or all of these affiliates participating in the augmentation

opportunity to be announced soon for target of community colleges/technical colleges.

- **Aeronautics research**. The Utah Space Grant Consortium has not supported faculty or higher education student research in the subject of aeronautics research in FY 2013. However, the Hill Aerospace Museum, an affiliate of our Consortium, promoted aeronautics to K-12 teachers and students through camps and workshops. The Hill Aerospace Museum also has an in-service teacher program which provided 35 teachers new ideas for bringing aerospace and STEM into their classrooms. This program is in partnership with the Civil Air Patrol and the Air Force Association. The Hill Aerospace Museum also conducts "Robotics Day" each fall where the Museum and Weber State University College of Applied Science and Technology undergraduates teach students in grades 7-12. The Hill Aerospace Museum also had eight college interns during FY 2013 earning funds for their education and getting hands-on experience working in a museum and with other students. Hill Aerospace Museum also hosted three high school career programs where students were in a job shadow atmosphere. Future plans at the Hill Aerospace Museum include increasing the ACE (Aerospace Center for Education) facilities and expanding to a larger area. The ACE facility provides several school districts with day visits to enable hands-on experiences and promote interest in aerospace science. The Center has several interactive and participatory exhibits on aerodynamics, propulsion, rocketry, structures and materials, and simulation of flight.

- **Environmental Science and Global Climate Change**. Utah Space Grant supported a number of students via fellowships and scholarships in FY 2013 who were doing their research in the areas of environmental science and global climate change. Josh Maurer, graduate fellowship student at Brigham Young University, performed research during this year on the evaluation of hexagon imagery for regional mass balance study in the Bhutan Himalayas. Josh was able to obtain results indicating that the Hexagon imagery database represents a largely untapped resource for understanding decadal scale patterns of mass balance in the region. Leda Sox, graduate fellowship student at Utah State University, has been studying the middle atmosphere temperature results from a new, high-powered large-aperture Rayleigh lidar. This research allowed observations of the annual temperature minimum in the upper mesosphere-lower thermosphere region. This new capability for the ALO Rayleigh lidar has opened the potential for new discoveries in this hard-to-observe region. A group of undergraduate students at Weber State University denoted as the "HARBOR" Team (High-Altitude Reconnaissance Balloon for Outreach and Research), has been able to perform research utilizing stratospheric weather balloons. Concentrations of O_3, CO_2, CO, and NO are being measured from ground-level to the mid-stratosphere. These gases directly affect both climate change and ground-level pollution. An environmental test chamber has been constructed to simulate the atmospheric conditions experienced by high-altitude, near-space flights.

- **Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities**. Our Consortium continues to support innovative research infrastructure activities to early career faculty by advertising research infrastructure project funding at our three research universities (University of Utah, Utah State University, and Brigham Young University). We planned a total of five research infrastructure minigrant awards in FY 2013. At the current time, two research infrastructure minigrant awards have been granted and an additional three awards are being advertised and planned to be funded in the near future. Our focus is to help faculty focus their research toward NASA priorities and to help them make better ties to NASA Centers and prepare proposals for additional outside NASA funding. The two research infrastructure minigrant awards that have been awarded so far include: (1) POCPACS Space Weather project which was deployed into orbit on a SpaceX Falcon 9 rocket on September 31, 2013, at Utah State University, Dr. Gil Moore. POCPAS is a constellation of three 4-inch spheres placed into a polar orbit. These three satellites have different masses which provides different satellite drag coefficients and subsequently, different sensitivities to upper atmospheric drag changes caused by space weather. (2) Balloon Flight Measurements with a Red-Line Airglow Sensor (RLAGS), at Utah State University, Dr. Rees Fullmer. As part of this project, students will design a Cubesat-like instrument to collect and model experimental airglow intensity emissions in the upper atmosphere using a sensor on a NASA provided high altitude balloon flight enhancing courses in physics, mechanical, electrical and computer engineering at Utah State University.

IMPROVEMENTS MADE IN THE PAST YEAR

The Utah NASA Space Grant Consortium is pleased to announce that the UNSGC student papers presented at the annual Symposium since 2000 are now available on-line through the Digital Commons library archived system. This nationally recognized archive is author researchable which enables student authors works to be electronically found. The UNSGC has evolved from the former Rocky Mountain NASA Space Grant Consortium (RMNSGC) and the earlier symposia carry the RMNSGC identifier, but it is our UNSGC students nonetheless. Access to this site is obtained as follows: http://digitalcommons.usu.edu/spacegrant/ and thereafter the years 2000 through 2013 are the gateway clicks to the respective annual symposia. UNSGC thanks the enthusiasm, energy, and work our USU librarians and their staff undertook to bring this project to fruition. We further have a great debt of gratitude to Professor Doran Baker whose vision of creating the symposium and the proceedings has enable the archive to be created. Our Digital Commons front page acknowledges this rocket scientist.

Improvements in the area of research infrastructure funds are currently being planned for FY 2014 to be implemented starting in May 2014 with year 5 funding. We have been allocating funds to University of Utah, Brigham Young University, and Utah State University to internally advertise and award research infrastructure opportunities and then issue at these various institutions. Our improvements for the future include opening up this allotment of funds to the entire set of Space Grant affiliates to propose for and

advertising these opportunities earlier in the fiscal year so that the projects are well underway and results are available before the annual reports are due. This will allow us to more effectively distribute the funds across the State as well as more accurately report on the success of these programs. Utah Space Grant has formulated a new RFP document to advertise our budgeted research infrastructure funds and we will be discussing this change and plans for implementation at our annual meeting to be held on May 6, 2014. More details and further results will be reported in our annual performance document for FY 2014.

The Utah Space Grant Consortium has continued to target improved communication within our Space Grant by requesting feedback from affiliates and keeping them informed of upcoming opportunities, events, and activities. We have been working more closely with our university internal offices, refining our invoice review process of subcontracts, and working more closely and effectively with grants and contracts accounting and sponsored programs offices at our lead institution, namely the University of Utah.

In FY 2013, we have been working on implementing improvements in our fellowship application process through our website applications and established a set of terms and agreements with fellowship student awardees on what is to be expected, reporting requirements, standards, and guidelines. Also, our affiliates who are awarding fellowships and scholarships have been able to leverage the funding at a higher level by cost-sharing match with increased scholarship awards to recipients. This has allowed us to make more awards to students in a broader area of disciplines.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Education and Research Universities:

(1) **University of Utah** is a four-year university and also serves as the lead institution for the Utah Space Grant Consortium. The University of Utah awards graduate fellowships and undergraduate scholarships and provides graduate student mentors in life sciences. The University of Utah also supports higher education programs involving student research and research infrastructure projects for faculty and students. http://www.utah.edu/

(2) **Utah State University** is a four-year university. Utah State University awards graduate fellowships and undergraduate scholarships and provides graduate student mentors in space vehicle propulsion, space systems engineering and physics. Utah State University also supports higher education programs involving student research and research infrastructure projects for faculty and students. http://www.usu.edu/

(3) **Brigham Young University** is a four-year university. Brigham Young University awards graduate fellowships and undergraduate scholarships and provides graduate student mentors in remote sensing. Brigham Young University also supports higher

education programs involving student research and research infrastructure projects for faculty and students. http://www.byu.edu/

Industry:

(4) **ATK Aerospace Systems** is an industrial partner of the Utah Space Grant Consortium. ATK is a global aerospace, defense and commercial products company. ATK provides internship opportunities for graduate and undergraduate students and they support workshops for female students and teachers. ATK is also an annual contributor to the Space Grant Alliance program. https://www.atk.com/business-groups/atk-aerospace/

Education Institutions:

(5) **Weber State University** is a four-year university. Weber State participates in higher education programs through the College of Science on their campus. Weber State is also involved in a hands-on outreach program for the public in conjunction with the Ott Planetarium. https://www.weber.edu/

(6) **Southern Utah University** is a four-year university. Southern Utah University participates in Higher Education programs and provides undergraduate and graduate student mentors in the STEM fields to students in the College of Science and Engineering. They also participate in the science Olympiad and science and engineering fair. https://www.suu.edu/

(7) **Snow College** is a two-year college which prepares students to go onto a four-year university in the STEM fields. They also work with the K-12 schools within their region through the use of their portable planetarium, science Olympiad and math contents. https://www.snow.edu/

(8) **Dixie State University** is a four-year university which focuses on preparing K-12 teachers in biology and physical sciences in our Higher Education programs. Dixie State also supports higher education students to provide astronomy nights on their campus to educate the campus and the community in the area of astronomy. http://www.dixie.edu/

(9) **Utah College of Applied Technology** is comprised of eight applied technology college campuses across the State of Utah. UCAT emphasizes the importance of technical training and improving skills in the workplace today. They provide higher education student scholarship opportunities to help students advance their skills in various areas of applied technology. http://ucat.edu/

(10) **Salt Lake Community College** is a two-year college which prepares students to transfer to larger colleges and universities to pursue their degrees. Salt Lake Community College provides higher education programs through physics, chemistry, biology, and engineering course development and student internships to mentor in the SLCC Science Resource Center. http://www.slcc.edu/

(11) **Westminster College** is a four-year college that participates in higher education and outreach programs. Westminster provides undergraduate research in the sciences and

they also support an outreach summer program for precollege women students on their campus. http://www.westminstercollege.edu/

(12) **Utah Valley University** is a four-year university. Utah Valley University participates in higher education programs by providing opportunities for students in astrophysics research, science and engineering. Utah Valley University also supports outreach through planetarium shows and workshops geared toward females to interest them in the STEM fields. https://www.uvu.edu/

Government Centers:

(13) **Idaho National Laboratory** is a science-based, applied engineering national laboratory dedicated to supporting the U.S. Department of Energy's missions in nuclear and energy research, science, and national defense. The Idaho National Laboratory provides summer internships for Space Grant students as well as serves in an advisory capacity on reviewing proposals and awards. https://inlportal.inl.gov/portal/server.pt/community/home/255

(14) **Space Dynamics Laboratory** is a nonprofit research corporation and a unit of the Utah State University Research Foundation. The Space Dynamics Laboratory's mission is to advance scientific and defensive objectives by researching, developing and characterizing sensor, electronic, and software systems; providing program lifecycle support; and enhancing the education and development of scientists and engineers. SDL provides Space Grant internships for students in space vehicle propulsion. http://www.sdl.usu.edu/

(15) **Hill Air Force Base** is the 75th Air Base Wing, one of five wings under the Ogden Air Logistics Complex, supports all wings of the Ogden ALC, two fighter wings, 46 other associate units, and directly supports Air and Space Expeditionary Force operations. The 75th Air Base Wing also has base support responsibility or the operation of the 1,500-square-mile Utah Test and Training range. Hill Air Force Base provides internships for Space Grant students as well as serves in an advisory capacity on reviewing proposals and awards. http://www.hill.af.mil/

Outreach Institutions:

(16) **Clark Planetarium** is a planetarium as a division of Salt Lake County and aims to create and present enlightening experiences that inspire wonder in learning about space and science, and to promote greater public awareness of the science in our daily lives. Clark Planetarium works with Utah Space Grant to provide teacher workshops and informal education and outreach to the community. http://clarkplanetarium.org/

(17) **Aerospace Heritage Foundation of Utah/Hill Aerospace Museum** is located on approximately 30 acres on the northwest corner of Hill Air Force Base. The museum was founded in 1981 as part of the United States Air Force Heritage Program. The Museum exhibits more than 90 military aircraft, missiles, and aerospace vehicles on the grounds and inside the galleries. Hill Aerospace Museum partners with Utah Space Grant to provide teacher workshops through their Aerospace Education Center (ACE) and provides informal education and public outreach. http://www.hill.af.mil/library/museum/

(18) **North American Native Research & Education Foundation** is a nonprofit research and educational foundation that targets Native American groups. Together with Utah Space Grant, the North American Native Research & Education Foundation conducts teacher workshops for Native Americans and targets youth services programs that benefit this group. http://non-profit-organizations.findthebest.com/l/1538811/North-American-Native-Research-And-Education-Foundation-Inc

(19) **The Leonardo** is a contemporary museum that explores the unexpected ways that science, technology, art and creativity connect. The Leonardo houses one-of-a-kind, interactive exhibits and participates in ever-changing programs, workshops and classes. The Leonardo works with Space Grant to provide public outreach and internships to students to develop the exhibits and displays. http://www.theleonardo.org/